Mission Requirements and Assumptions

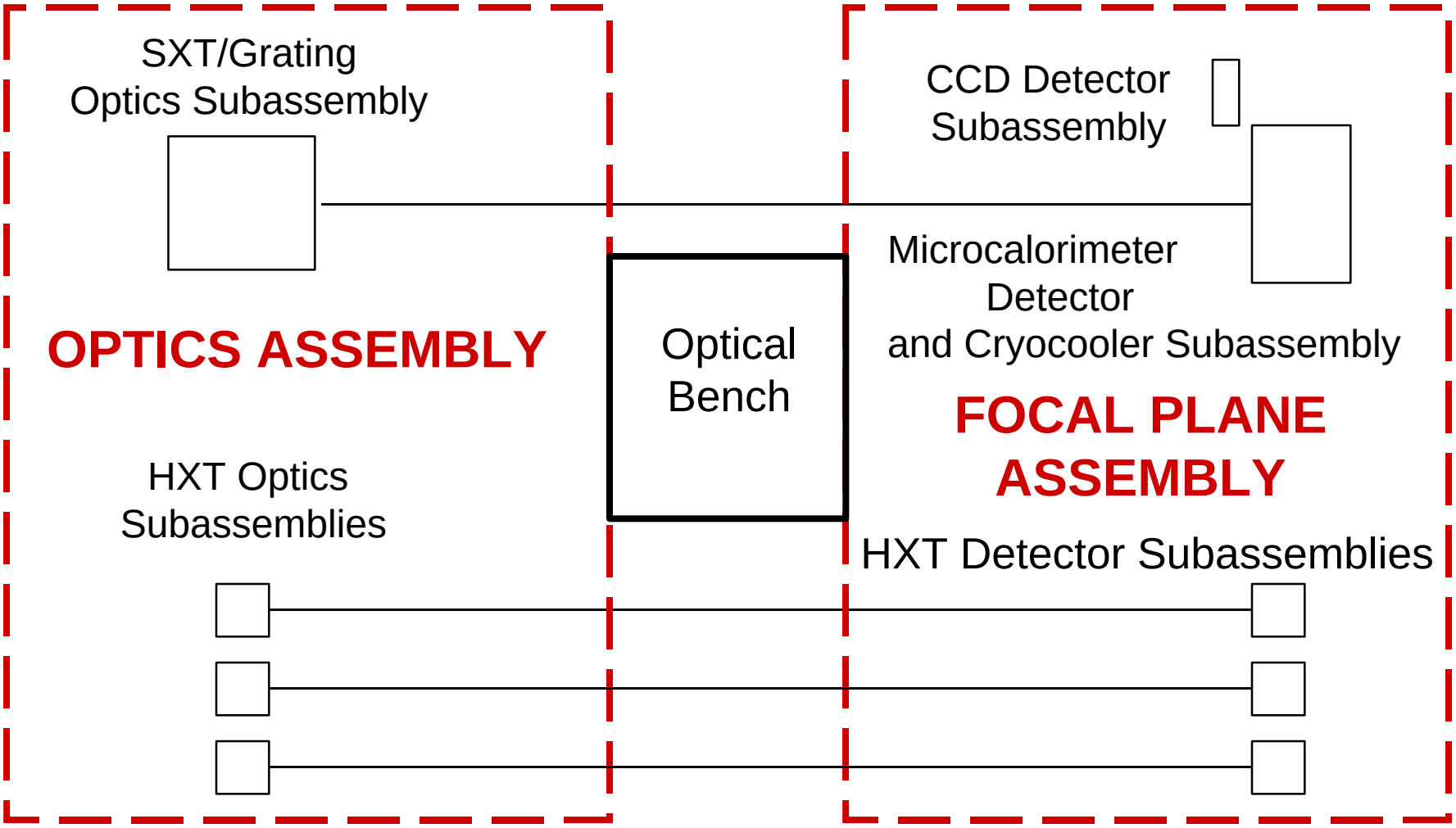
Mission Requirements Overview

Two coaligned Telescope systems to cover the 0.25-40keV band:

- Spectroscopy X-ray Telescope(SXT) from 0.25 to 10.0keV
  - Microcalorimeter array (or equivalent) with 2eV resolution
  - Reflection grating/CCD array (or equivalent) with resolution > 300
  - for energies below 1keV
- Hard X-ray Telescope(HXT) from 10 to 40 keV
  - Small radius grazing incidence optics with multilayer coatings
  - CdZnTe imaging detector (or equivalent)

Science instrumentation configured into separate optics and focal plane assemblies. Optical bench provides stable structure between the two.

Science Instrumentation Concept



Top Level Mission Performance Requirements

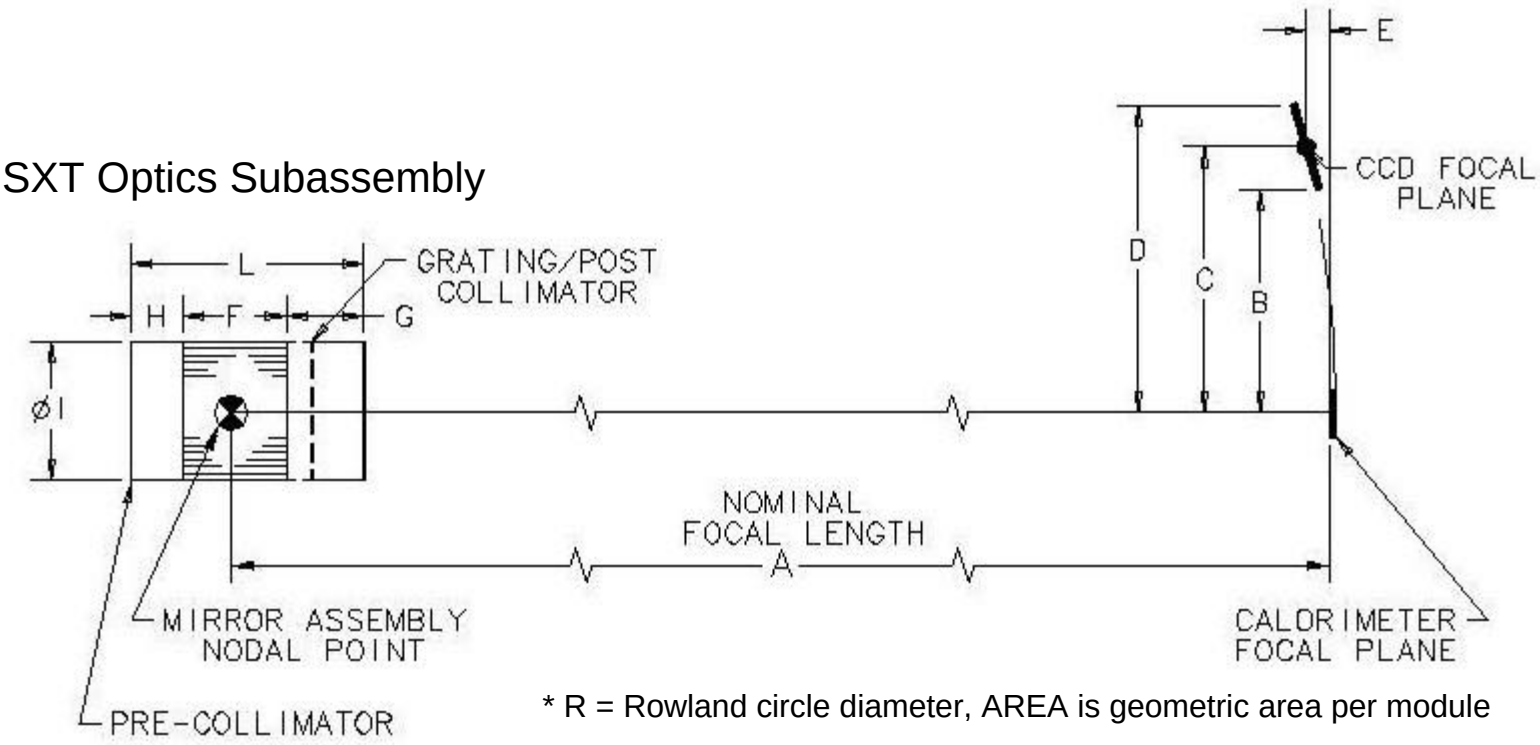
Effective Area - Mission Total	15,000 cm^2 @1keV (30,000 cm^2 geometric area) - SXT 6,000 cm^2 @ 6.4 keV - SXT 1,500 cm^2 @ 40 keV - HXT
Telescope Angular Resolution	15” HPD from 0.25 to 10 keV (SXT) 1’ above 10keV (HXT)
Minimum Spectral Resolving Power	300 from 0.25 keV to 10.0 keV 3000 at 6 keV 10 at 40 keV
Band Pass	0.25 to 40 keV
Minimum Diameter Field of View	2.5’<10 keV 8’>10 keV
Redundancy/Reliability	No one failure to result in loss of more than 33% of the mission science
Mission Life	3 years minimum at full performance 5 years goal

Target Viewing Constraints

- The effective area (EA) specified above assumes viewing efficiency(average per orbit) > 90% over the mission life. For orbits with lower viewing efficiencies, the total mission effective area (SXT+ HXT) must increase proportionately, or the duration of mission must increase to compensate for the loss in viewing efficiency (TBR).
- The full EA must available for use on the same target at the same time.
- Observations of a single target will generally be from 2 to 48 hours in duration.
- Targets will be distributed throughout the entire celestial sphere.
- We require that 90% of the sky be accessible at least twice per year, with viewing windows no shorter than two weeks in duration; and that 100% of the sky be available at least once per year with a minimum viewing window of one week.
- Mission orbits and attitude control shall be adjusted to provide the above.

SXT Options and Geometry

SXT Optics Subassembly



* R = Rowland circle diameter, AREA is geometric area per module

	A	B	C	D	E	F	G	H	ØI	L	R*	AREA CM**2
SHORT 1.3M	8400	500	640	780	25.6	600	450	300	1400	1350	8000	4948
LONG 1.3M	8400	480	604	728	23.7	1000	450	300	1400	1750	7700	5456
1.8M	10000	584	737	890	28.9	1000	450	500	1980	1950	9400	15925

NOTE: Designs for 1.3m SXT should be based on 1.3m LONG option(1m optic length, dim F).

SXT Configuration Data

Parameter	Long 1.3m	1.8m
SXT Optics Subassembly		
Number of shells	60	90
Mass estimates(kg)		
Optics	250	824
Structure	103	200
Thermal HW	30	60
Contamination covers	14	30
Apertures/baffles	15	30
Reflection Gratings	50	70
Total	462	1214
Heater Power(watts)	150(TBR)	250(TBR)
Operating Temperature	20 C ± 1 C	20 C ± 1 C
Optics radial gradient	< 0.5C	< 0.5C
Optics axial gradient	< 1.0C	< 1.0C
Grating axial gradient	< 1.0C	< 1.0C

CCD Configuration Data

- A CCD detector (or equivalent) is used as a readout device for the reflection grating spectrometer spectra (one/SXT). The positioning of the CCD is shown in the SXT Options and Geometry slide.

- CCD configuration data:

	Envelope(mm)	Mass(kg)
• Detector assembly:	100 x 100 x 400	20
Array length(1.3m optic):	280	
Array length(1.8m optic):	310	
• Electronics box 1:	100 x 100 x 100	8
• Electronics box 2:	100 x 100 x 100	8
• Instrument Processor assembly:	200 x 400 x 100	12

- CCD operational temperature: -90C

- Total power: 40 watts

Microcalorimeter Configuration Data

- A microcalorimeter detector (or equivalent) will be located at the SXT focus (one/SXT).

- Microcalorimeter configuration data:
  - Operating Temperature: 0.065 +/- 0.002 deg K (TBR)
  - Total mass: 30 kg
  - Total power: 100 watts
  - Envelope: TBD

- Microcalorimeter REFERENCE data:
  - Focal Plane: 32 x 32 pixels, each 200 x 200 microns
  - Detector FOV: 2.5 arcmin x 2.5 arcmin (minimum)

HXT Optics Configurations

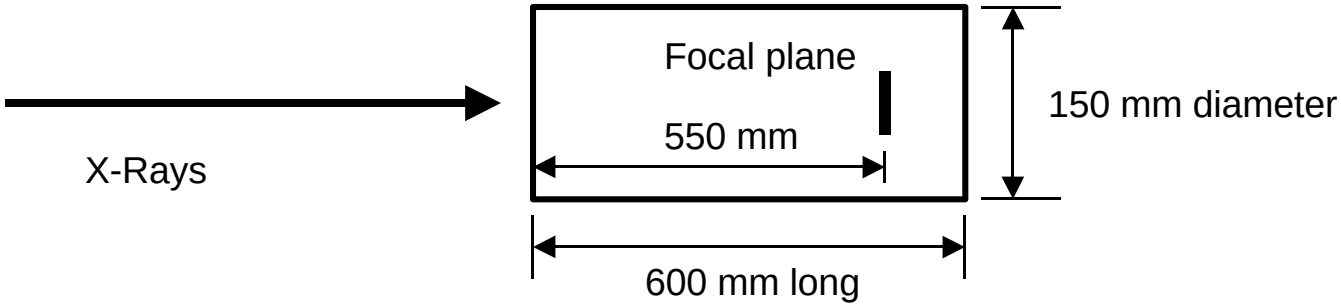
- The high energy imaging capability is provided by an HXT optics module coupled to a CdZnTe imaging detector (or equivalent).
- Three HXT optics module options are defined

	Optic Dia(mm)	Assembly Dims Dia x Length(mm)	Focal Length(m)	Optic FOV (arcmin)	Optics per mission	Mass (kg)
1 - Base	280	330 x 200	9.0	>8	18	26
2	400	450 x 300	10.5	>8	12	55
3	330	380 x 300	10.5	>8	15	38

HXT Detector Configuration Data

- HXT Detector configuration data:
  - Operating temperature: -40C
  - Mass: 17 kg
  - Focal plane dimensions: 25mm x 25mm

- Envelope dimensions:



Pointing and Data Requirements

<u>Pointing</u>	
Pointing Knowledge	2 arc sec, pitch and yaw
	30 arc sec, roll
Pointing Control	30 arc sec, pitch and yaw
	60 arc sec, roll
Pointing Stability	0.5 arc sec/sec (TBR), pitch and yaw
	5 arc sec/sec, roll
Safety Pointing Constraints	$\geq$ 45 deg from Sun
Science Pointing Constraints	$\geq$ 45 deg from Sun
	$\geq$ 30 deg from earth limb and moon
<u>Data</u>	
Science and Instrument Engineering Data Rate (Mission Total Daily Average)	192 kbps
Peak Science Data Rate and mission peak data rate:	5460 kbps(sum of all satellites)

Stray Light, Stray X-Ray, and Radiation Requirements

Stray Light	
Stray Light on CCD	**< 1e9 photons/cm2/sec (in 1000 to 10,000 angstrom band)**
Stray Light on microcalorimeter	**TBD**
Stray Light on HXT detectors	**no limit**
Stray X-rays	
Unfocused X-rays	**Protection equivalent to 0.005" tantalum over solid angles outside SXT FOV**
Radiation	
Radiation – Total Dose	**TBD**
Radiation – Galactic Cosmic Environment	**TBD**

NOTE: Instruments cannot operate in South Atlantic Anomaly